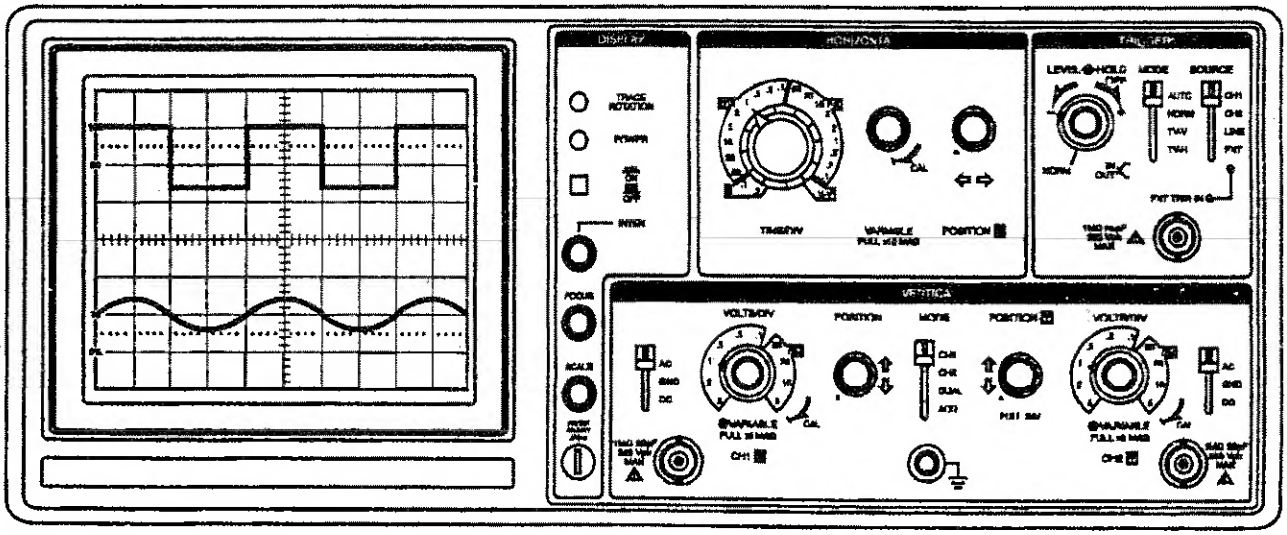
INSTRUCTION MANUAL

B&K PRECISION

MODEL 1541C

40 MHz
DUAL-TRACE OSCILLOSCOPE



B&K PRECISION

TEST INSTRUMENT SAFETY

WARNING

Normal use of test equipment exposes you to a certain amount of danger from electrical shock because testing must often be performed where exposed high voltage is present. An electrical shock causing 10 milliamps of current to pass through the heart will stop most human heartbeats. Voltage as low as 35 volts dc or ac rms should be considered dangerous and hazardous since it can produce a lethal current under certain conditions. Higher voltage poses an even greater threat because such voltage can more easily produce a lethal current. Your normal work habits should include all accepted practices that will prevent contact with exposed high voltage, and that will steer current away from your heart in case of accidental contact with a high voltage. You will significantly reduce the risk factor if you know and observe the following safety precautions:

1. Don't expose high voltage needlessly in the equipment under test. Remove housings and covers only when necessary. Turn off equipment while making test connections in high-voltage circuits. Discharge high-voltage capacitors after removing power.
2. If possible, familiarize yourself with the equipment being tested and the location of its high voltage points. However, remember that high voltage may appear at unexpected points in defective equipment.
3. Use an insulated floor material or a large, insulated floor mat to stand on, and an insulated work surface on which to place equipment; make certain such surfaces are not damp or wet.
4. Use the time-proven "one hand in the pocket" technique while handling an instrument probe. Be particularly careful to avoid contacting a nearby metal object that could provide a good ground return path.
5. When using a probe, touch only the insulated portion. Never touch the exposed tip portion.
6. When testing ac powered equipment, remember that ac line voltage is usually present on some power input circuits such as the on-off switch, fuses, power transformer, etc. any time the equipment is connected to an ac outlet, even if the equipment is turned off.
7. Some equipment with a two-wire ac power cord, including some with polarized power plugs, is the "hot chassis" type. This includes most recent television receivers and audio equipment. A plastic or wooden cabinet insulates the chassis to protect the customer. When the cabinet is removed for servicing, a serious shock hazard exists if the chassis is touched. Not only does this present a dangerous shock hazard, but damage to test instruments or the equipment under test may result from connecting the ground lead of most test instruments (including this oscilloscope) to a "hot chassis". To make measurements in "hot chassis" equipment, always connect an isolation transformer between the ac outlet and the equipment under test. The **B+K Precision** Model TR-110 or 1604 Isolation Transformer, or Model 1653 or 1655 AC Power Supply is suitable for most applications. To be on the safe side, treat all two-wire ac power equipment as "hot chassis" unless you are sure it has an isolated chassis or an earth ground chassis.
8. Never work alone. Someone should be nearby to render aid if necessary. Training in CPR (cardio-pulmonary resuscitation) first aid is highly recommended.

Instruction Manual

for

B+K PRECISION

Model 1541C

40 MHz

Dual-Trace Oscilloscope

This symbol on oscilloscope means "refer to instruction manual for further precautionary information". This symbol appears in the manual where the corresponding information is given.

B+K PRECISION

MAXTEC INTERNATIONAL CORP.

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11. **VARIABLE/PULL X5 MAG Control**
VARIABLE: Rotation provides vernier adjustment of channel 1 vertical gain. In the fully clockwise (**CAL**) position, the vertical attenuator is calibrated at the maximum gain point. Counterclockwise rotation decreases gain. In the X-Y operation this control becomes the vernier X-axis gain control.

PULL X5 MAG: (Push-Pull Switch): Multiplies the channel 1 gain five times; for example, 5 mV/div. sensitivity becomes 1 mV/div. sensitivity.

12. **POSITION Control:** Rotation adjusts vertical position of channel 1 trace.

VERTICAL MODE CONTROLS

13. **VERTICAL MODE Switch:** Selects vertical display modes as follows:

CH1: Only the input signal to Channel 1 is displayed on the CRT.

CH2: Only the input signal to Channel 2 is displayed on the CRT.

DUAL: Both channel 1 and channel 2 signals are displayed simultaneously.

CHOP: TIME/DIV. 0.2 s to 5 ms

ALT: TIME/DIV. 2ms to 0.1μs

ADD: Displays the algebraic sum of the channel 1 and channel 2 signals. When CHANNEL 2 invert is enabled, the algebraic difference between channel 1 and channel 2 signals is displayed.

14. **Gnd Terminal:** Oscilloseope chassis ground and earth ground via 3-wire ac power cord

CHANNEL 2 CONTROLS

15. **POSITION Control:** Rotation adjusts vertical position of channel 2 trace. In X-Y operation, rotation adjusts vertical position of display.

PULL INV: When pulled out the channel 2 signal is inverted.

16. **VOLTS/DIV. Control.** Vertical attenuator for channel 2. Provides step adjustment of vertical sensitivity. When Channel 2 **VARIABLE** control (17) is set to **CAL**, vertical sensitivity is calibrated in 10 steps from 5 mV/div. to 5 V/div. in a 1-2-5 sequence. In X-Y operation, this control provides step adjustment of Y-axis sensitivity.

17. **VARIABLE/PULL X5 MAG Control**

VARIABLE: Rotation provides vernier adjustment of channel 2 vertical gain. In the fully clockwise (**CAL**) position, the vertical attenuator is calibrated at the maximum gain point. Counterclockwise rotation decreases gain. In the X-Y operation this control becomes the vernier Y-axis gain control.

PULL X5 MAG: (Push-Pull Switch): Multiplies the channel 2 gain five times; for example, 5 mV/div. sensitivity becomes 1 mV/div. sensitivity.

18. **CH2 (Y) Input Jack.** Vertical input for channel 2. Y-axis input for X-Y operation.

19. **AC-GND-DC Switch.** Three position lever switch operates as follows:

AC: Channel 2 input signal is capacitively coupled; dc component is blocked

GND: Opens signal path and grounds input to vertical amplifier. This provides a zero-volt base line, the position of which can be used as a reference when performing dc measurements.

DC: Direct coupling of channel 2 input signal; both ac and dc component of signal produce vertical deflection.

TRIGGERING CONTROLS

20. **EXT TRIG IN Jack:** External trigger input.

21. **TRIGGER SOURCE Switch:**

CH1: Channel 1 input signal becomes sweep trigger.

CH2: Channel 2 input signal becomes sweep trigger.

LINE: Signal derived from input line voltage (50/60 Hz) becomes trigger.

EXT: Signal from **EXT TRIG** jack becomes sweep trigger.

22. **TRIGGER MODE Switch:**

AUTO: Selects automatic triggering mode, using free-running sweep in absence of trigger; automatically reverts to triggered sweep operation when adequate trigger signal is present.

NORM: Selects normal triggered sweep operation, which generates a sweep only when an adequate trigger signal is present.

TV-V: Connects a video sync separator to enable vertical sync pulses to be used as the sweep trigger.

TV-H: Connects a video sync separator to enable horizontal sync pulses to be used as the sweep trigger.

23. **TRIGGER HOLD OFF Control:** Rotation of this control adjusts holdoff time (time inhibit period beyond sweep duration). When control is rotated fully counterclockwise (**NORM** position), the holdoff period is minimum. The holdoff period increases progressively with clockwise rotation.

24. **TRIGGER LEVEL/Slope Control:**

    TRIGGER LEVEL Control: Determines point on the triggering waveform where the sweep is triggered. Rotation in the (-) direction selects a more negative point of triggering, and rotation in the (+) direction selects a more positive point of triggering.

    Slope (Push-Pull Switch): The pushed in position selects a positive going slope and the pulled out position selects a negative going slope.

SWEEP CONTROLS

25. **POSITION Control:** Adjusts horizontal position of display in all operating modes.

26. **VARIABLE/PULL X10 MAG**

    VARIABLE: Rotation of control is vernier adjustment for the sweep rate. In fully clockwise (**CAL**) position, sweep rate is calibrated.

    PULL X10 MAG: Selects ten times sweep magnification when pulled out, normal when pushed in. Increases maximum sweep rate to 10 ns/div.

27. **TIME/DIV Switch:** Provides step selection of sweep rate. When the **VARIABLE** sweep control (26) is set to **CAL**, sweep rate is calibrated. This control has 19 steps from .2μs to .2s per division in a 1-2-5 sequence. This control also enables the X-Y operating mode.

REAR PANEL

28. **EXT BLANKING INPUT:** Input jack for intensity modulation of CRT electron beam. TTL compatible (5 volts p-p sensitivity). Positive signal levels decrease intensity.

29. **CH1 OUTPUT Jack:** Output jack where channel 1 signal is available. Amplitude of output is nominally 20 mV/div of vertical deflection seen on CRT when terminated into 50Ω. Output impedance is 50Ω .

30. **Power Cord Receptacle.**

31. **Line Voltage Selector and Fuse Holder:** Selects line voltage. Plug inserts four ways for 100, 120, 220, and 240 V line voltage. Arrow on holder aligns with the selected line voltage marker on the insert. Line fuse is inside.

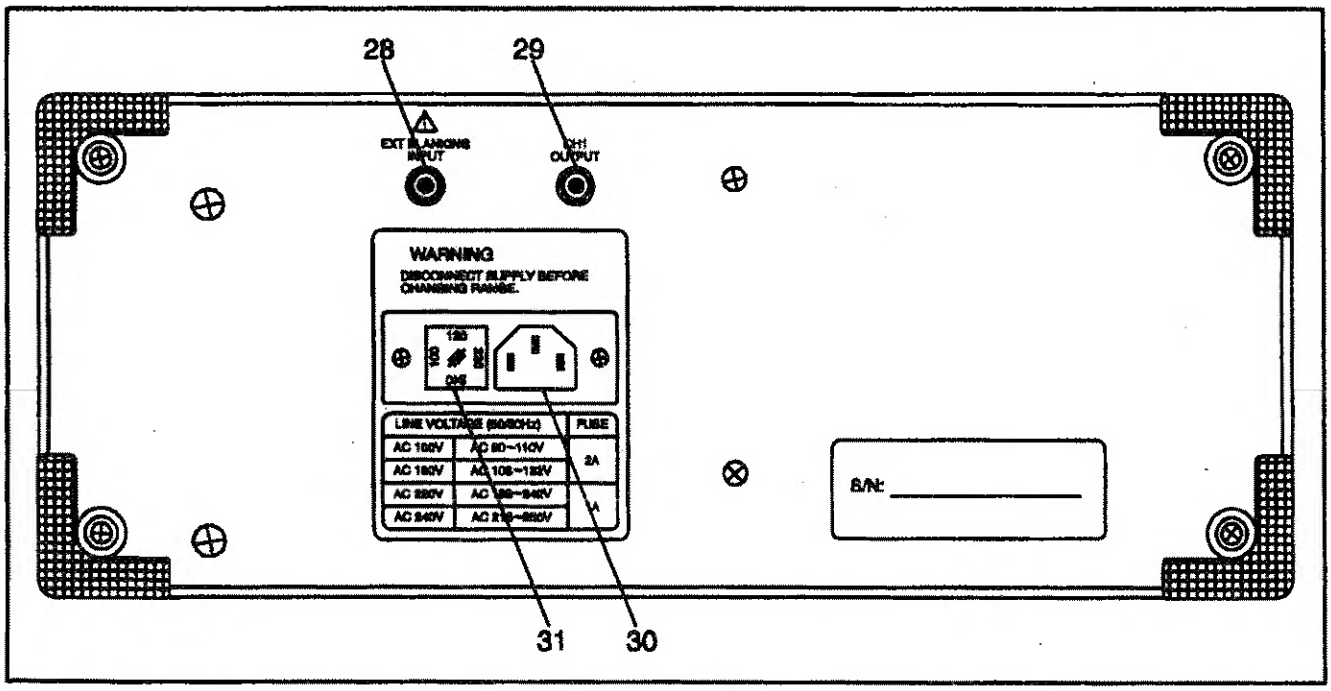

Fig. 2. Rear Panel

OPERATING INSTRUCTIONS

SAFETY PRECAUTIONS

WARNING

The following precautions must be observed to prevent electric shock

1. When the oscilloscope is used to make measurements in equipment that contains bigb voltage, there is always a certain amount of danger from electrical shock. The person using the oscilloscope in such conditions should be a qualified electronics technician or otherwise trained and qualified to work in such circumstances. Observe the TEST INSTRUMENT SAFETY recommendations listed on the inside front cover of this manual.
2. Do not operate this oscilloscope with the case removed unless you are a qualified service technician. High voltage up to 11,500 volts is present when the unit is operating with the case removed.
3. The ground wire of the 3-wire ac power plug places the chassis and housing of the oscilloscope at earth ground. Use only a 3-wire outlet, and do not attempt to defeat the ground wire connection or float the oscilloscope; to do so may pose a great safety hazard.
4. Special precautions are required to measure or observe line voltage waveforms with any oscilloscope. Use the following procedure:

   a. Do not connect the ground clip of the probe to either side of the line The clip is already at earth ground and touching it to the hot side of the line may "weld" or "disintegrate" the probe tip and cause possible injury, plus possible damage to the scope or probe.

   b. Insert the probe tip into one side of the line voltage receptacle, then the other. One side of the receptacle should be "bot" and produce the waveform. The other side of the receptacle is the ac return and no waveform should result.

EQUIPMENT PROTECTION PRECAUTIONS

CAUTION

The following precautions will help avoid damage to the oscilloscope.

1. Never apply external voltage to oscilloscope output jacks (CH1 OUTPUT jack or PROBE ADJUST terminal).
2. Excessive voltage applied to the input jacks may damage the oscilloscope. The maximum ratings of the inputs are as follows:

   

   CH1 (X) and CH2 (Y):
   250 V (DC + AC peak)
   EXT TRIG:
   250 V (DC + AC peak)
   EXT BLANKING INPUT:
   30 V (DC + AC Peak)
3. Never allow a small spot of high brilliance to remain stationary on the screen for more than a few seconds. The screen may become permanently burned. A spot will occur when the scope is set up for X - Y operation and no signal is applied. Either reduce the intensity so the spot is barely visible, apply a signal, or switch back to normal sweep operation. It is also advisable to use low intensity with AUTO triggering and no signal applied or when a stored waveform is displayed for long periods. A high intensity trace at the same position could cause a line to become permanently burned onto the screen.
4. Do not rest objects on top of the oscilloscope or otherwise obstruct the ventilating boles in the case, as this will increase the internal temperature.
5. Always connect a cable from the ground terminal of the oscilloscope to the chassis of the equipment under test. Without this precaution, the entire current for the equipment under test may be drawn through the probe clip leads under certain circumstances. Such conditions could also pose a safety hazard, which the ground cable will prevent.
6. The probe ground clips are at oscilloscope ground and should be connected only to the common of the equipment under test. To measure with respect to any point other than the common, use

CH1 - CH2 subtract operation (ADD mode and **PULL INV** switch engaged), with the channel 1 probe to the point of measurement and the channel 2 probe to the point of reference. Use this method even if the reference point is a dc voltage with no signal.

OPERATING TIPS

The following recommendations will help obtain the best performance from the oscilloscope.

1. Always use the probe ground clips for best results, attached to a circuit ground point near the point of measurement. Do not rely solely on an external ground wire in lieu of the probe ground clips, as undesired signals may be induced.
2. Avoid the following operating conditions:
   a. Direct sunlight.
   b. High temperature and humidity.
   c. Mechanical vibration.
   d. Electrical noise and strong magnetic fields, such as near large motors, power supplies, transformers, etc.
3. Occasionally check trace rotation, probe compensation, and calibration accuracy of the oscilloscope using the procedures found in the MAINTENANCE section of this manual.
4. Terminate the output of a signal generator into its characteristic impedance at the oscilloscope and use an interconnecting cable of the same impedance. This precaution will minimize ringing, especially if the signal has fast edges such as square waves or pulses. For example, the typical 50Ω output of a square wave generator should be terminated into an external 50Ω terminating load at the oscilloscope and connected to the oscilloscope with a 50Ω coaxial cable.
5. Probe compensation adjustment matches the probe to the input of the scope. For best results, compensation should be adjusted initially, then the same probe always used with the same channel. Probe compensation should be readjusted when a probe from a different oscilloscope is used.

INITIAL STARTUP PROCEDURE

Until you familiarize yourself with the use of all controls, the settings shown in Fig. 3 may be used as a reference point to obtain a trace on the CRT in preparation for waveform observation.

1. Engage the Power **ON-OFF** switch; the unit will be turned on and the green **POWER** indicator will light.
2. Set the controls as indicated in Fig. 3.
3. A trace should appear on the CRT. Adjust the trace brightness with the **INTEN**sity control, and the trace sharpness with the **FOCUS** control.

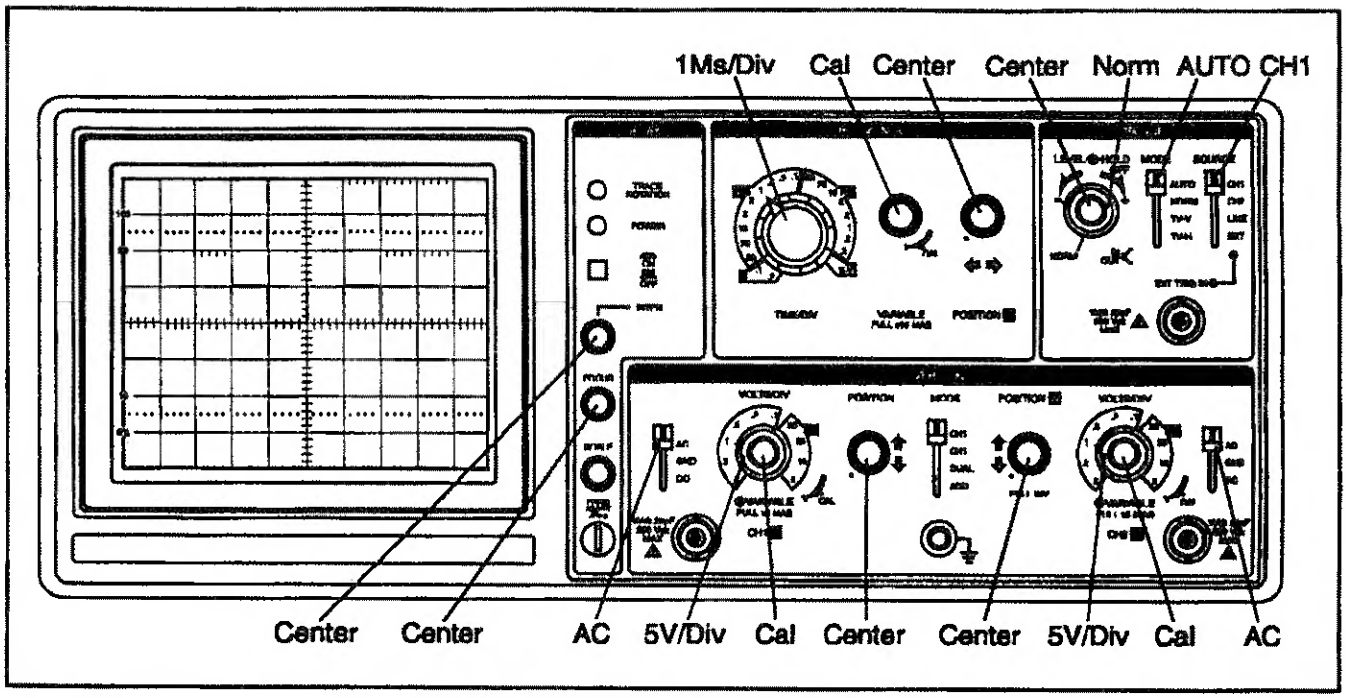

Fig. 3. Recommended Initial Settings

SINGLE TRACE DISPLAY

Either channel 1 or channel 2 may be used for single-trace operation. The advantage of using channel 2 is that the waveform on the display can be inverted if desired with **PULL INV** switch.

1. Perform the steps of the "Initial Starting Procedure".
2. Connect the probe to the **CH2 (Y)** input jack.
3. Connect the probe ground clip to the chassis or common of the equipment under test. Connect the probe tip to the point of measurement.
4. If no waveforms appear, increase the sensitivity hy turning the **CH2 VOLTS/DIV**. control clockwise to a position that gives 2 to 6 divisions vertical deflection.
5. The display on the CRT may be unsynchronized. Refer to the "Triggering" paragraphs in this section for procedures on setting triggering and sweep time controls to obtain a stahle display showing the desired number of waveforms.

DUAL TRACE DISPLAY

In observing simultaneous waveforms on channel 1 and channel 2, the waveforms are usually related in frequency, or one of the waveforms is synchronized to the other, although the basic frequencies are different. If the two waveforms have no phase or frequency relationship, there is seldom reason to observe both waveforms simultaneously.

1. Connect probes to both **CH1 (X)** and **CH2 (Y)** input jacks.
2. Connect the ground clips of the probes to the chassis or common of the equipment under test. Connect the tips of the probes to the two points in the circuit where waveforms are to be measured.
3. To view both waveforms simultaneously. set the VERTICAL **MODE** switch to **DUAL**. Both waveforms will be displayed.
4. When sweep times of 0.5 ms/div and faster are selected, the ALT display mode is automatically selected. When sweep times slower than 0.5 ms/div are selected, the CHOP display mode is automatically selected.
   a. In the ALT mode, one sweep displays the channel 1 signal and the next sweep displays the channel 2 signal in an alternating sequence. Alternate sweep is used for viewing high-frequency or high speed waveforms at sweep times of 2 ms/div and faster.
   h. In the CHOP mode, the sweep is chopped at an approximate 250 kHz rate and switched between channel 1 and channel 2. Chop sweep is used for low-frequency or low-speed waveforms at sweep times of 5 ms/div and slower. If chop sweep were to be used at sweep times of 2 ms/div and faster, the chop rate would become a significant portion of the sweep and could become visible in the displayed waveform.

5. Adjust the channel 1 and channel 2 **POSITION** controls to place the channel 1 trace above the channel 2 trace.
6. Set the CH1 and CH2 **VOLTS/DIV.** controls to a position that gives 2 to 3 divisions of vertical deflection for each trace. If the display on the screen is unsynchronized refer to the "Triggering" paragraphs in this section of the manual for procedures for setting triggering and sweep time controls to obtain a stable display showing the desired number of waveforms.

OTHER DISPLAYS

1. To view the algebraic sum of two waveforms set the VERTICAL **MODE** switch to **ADD** and be sure that the channel 2 **POSITION** control is pushed in. The waveform will be a single trace.
2. To view the algebraic difference between two waveforms, set the VERTICAL **MODE** switch to **ADD** and pull the **PULL INV** switch to the out position. The waveform will be a single trace.

TRIGGERING

The Model 154IC Oscilloscope provides versatility in triggering, allowing a stable, jitter-free display to be presented over a wide range of conditions. The proper settings depend upon the type of waveforms being observed and the type of measurement desired. An explanation of the various controls which affect synchronization is given to help you select the proper setting over a wide range of conditions.

TRIGGER MODE Switch

1. The **AUTO** position selects automatic sweep operation. The sweep generator continuously generates a sweep without a trigger signal. However, it automatically switches to triggered sweep operation if an adequate trigger source signal is present. The **AUTO** position is handy when first setting up the scope to observe a waveform; it provides a sweep for waveform observation until other controls can be properly set. Once the other controls are set, the trigger **MODE** switch is often switched to the **NORM** position because the normal triggered sweep mode is more sensitive. Automatic sweep operation must be used for dc measurements and signals of such low magnitude that they will not trigger the sweep.
2. The **NORM** position provides normal triggered sweep operation: The sweep remains at rest, until the selected trigger source signal crosses the threshold level set by the **TRIGGER LEVEL** control. The trigger causes one sweep to be generated, after which the sweep again remains at rest until triggered. In the **NORM** position, no trace is displayed unless an adequate trigger signal is present. Typically, signals that produce even 1/2 division of vertical deflection are adequate for normal triggered sweep operation.
3. **TV-V** position selects vertical sync pulses as the trigger. This position is used primarily for viewing fields of composite video waveforms.
4. **TV-H** position selects horizontal sync pulses as the trigger. This position is used primarily for viewing lines of composite video waveforms.

TRIGGER SOURCE Switch

The **TRIGGER SOURCE** switch selects the signal to be used as the sync trigger.

1. If the **TRIGGER SOURCE** switch is set to **CH1** (or **CH2**) the channel 1 (or channel 2) signal becomes the trigger source regardless of the **VERTICAL MODE** selection. **CH1** or **CH2** are often used as the trigger source for phase or timing comparison measurements.
2. If the **TRIGGER SOURCE** switch is set to the **LINE** position, triggering is derived from the input line voltage (50/60 Hz). This is useful for measurements that are related to line frequency.
3. If the **TRIGGER SOURCE** switch is set to the **EXT** position, the signal applied to the **EXT TRIG IN** jack is used as the trigger source. This signal must have a timing relationship to the displayed waveform(s) for a synchronized display.

TRIG LEVEL and SLOPE Control (Refer to Fig. 4)

A sweep trigger is developed when the trigger source signal crosses a preset threshold level. Rotation of the **TRIGGER LEVEL** control varies the threshold level. In the (+) direction, the triggering threshold shifts to a more positive value, and in the (-) direction, it shifts to a more negative value. When the control is centered, the threshold level is set at the approximate average of the signal used as the triggering source. Proper adjustment of this control usually synchronizes the display.

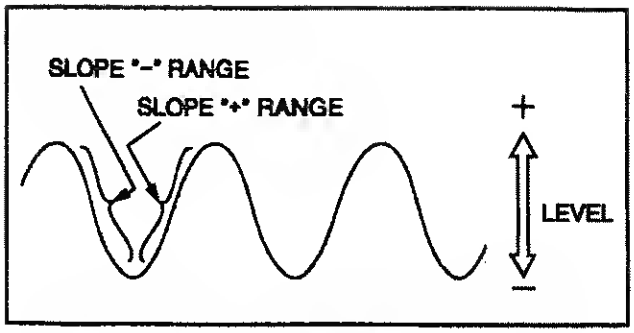

Fig. 4. Function of Slope and Level Control

The **TRIGGER LEVEL** control adjusts the start of the sweep to almost any desired point on a waveform. On sinewave signals, the phase at which sweep begins is variable. Note that if the **TRIGGER LEVEL** control is rotated toward its extreme (+) or (-) setting, no sweep will be developed in the normal trigger mode because the triggering threshold exceeds the peak amplitude of the sync signal.

When the **TRIGGER SLOPE** control is set to the (+) side , the sweep is developed from the trigger source waveform as it crosses a threshold level in a positive-going direction. When the **TRIGGER LEVEL** control is set to the (-) side , the sweep is developed from the trigger source waveform as it crosses a threshold level in a negative-going direction.

HOLDOFF CONTROL (Refer to Fig. 5)

A "holdoff" period occurs immediately after the completion of each sweep, and is a period during which triggering of the next sweep is inhibited. The normal holdoff period varies with sweep rate, but is adequate to assure complete retrace and stabilization before the next sweep trigger is permitted. The **HOLDOFF** control allows this period to be extended by a variable amount if desired.

This control is usually set to the **NORM** position (fully counterclockwise) because no additional holdoff period is necessary. The **HOLDOFF** control is useful when a complex series of pulses appear periodically such as in Fig. 5A. Improper sync may produce a double image as shown in Fig. 5B. Such a display could be synchronized with the sweep time variable control, but this is impractical because time measurements are then uncalibrated. An alternate method of synchronizing the display is with the **HOLDOFF** control. The sweep speed remains the same, but the triggering of the next sweep is "held off" for the duration selected by the **HOLDOFF** control. Turn the **HOLDOFF** control clockwise until the sweep starts at the same point of the waveform each time.

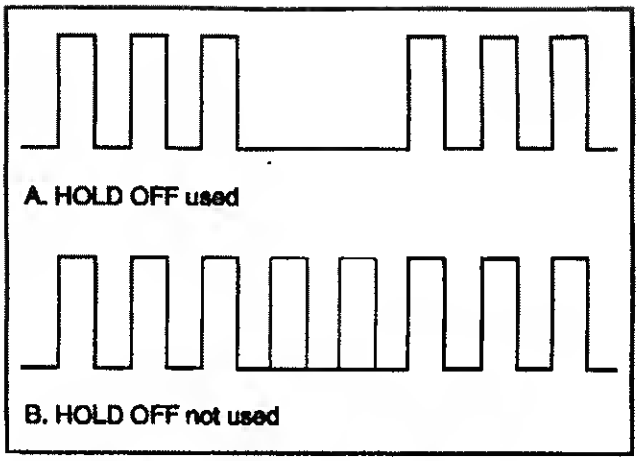

Fig. 5. Use of HOLDOFF Control

TIME BASE CONTROL

Set the **TIME/DIV.** control to display the desired number of cycles of the waveform. If there are too many cycles displayed for good resolution, switch to a faster sweep time. If only a line is displayed, try a slower sweep time. When the sweep time is faster than the waveform being observed, only part of the waveform will be displayed, which may appear as a straight line for a square wave or pulse waveform.

MAGNIFIED SWEEP OPERATION

Since merely shortening the sweep time to magnify a portion of an observed waveform can result in the desired portion disappearing off the screen, such magnified display should be performed using magnified sweep.

Using the **< > POSITION** control, adjust the desired portion of the waveform to the center of the CRT. Pull out the **X10 MAG** knob to magnify the display ten times. For this type of display the sweep time is the sweep **TIME/DIV.** setting divided by 10. Rotation of the **< > POSITION** control can then be used to select the desired portion of the waveforms.

X-Y OPERATION

X - Y operation permits the oscilloscope to perform many measurements not possible with conventional sweep operations. The CRT display becomes an electronic graph of two instantaneous voltages. The display may be a direct comparison of the two voltages such as stereoscope display of stereo signal outputs. However, the X - Y mode can be used to graph almost any dynamic characteristic if a transducer is used to change the characteristic (frequency, temperature, velocity, etc.) into a voltage. One common application is frequency response measurements where the Y axis corresponds to signal amplitude and the X axis corresponds to frequency.

1. Set the **TIME/DIV** switch to the **X - Y** position. In this mode, channel 1 becomes the X axis input and channel 2 becomes the Y axis input.
2. The X and Y positions are now adjusted using the **HORIZONTAL POSITION** and **CH2 POSITION** control respectively.
3. Adjust the amount of vertical (Y axis) deflection with the **CH2 VOLTS/DIV** and **VARIABLE** controls.
4. Adjust the amount of horizontal (X axis) deflection with the **CH1 VOLTS/DIV** and **VARIABLE** controls.

VIDEO SIGNAL OBSERVATION

Setting the **TRIGGER MODE** switch to **TV-H** or **TV-V** position permits selection of horizontal or vertical sync pulses for sweep triggering when viewing composite video waveforms.

When the **TV-H** mode is selected, horizontal sync pulses are selected as triggers to permit viewing of horizontal lines of video. A sweep time of about 10 µs/div. is appropriate for displaying lines of video. The **VARIABLE** sweep control can be set to display the exact number of waveforms desired.

When **TV-V** mode is selected, vertical sync pulses are selected as triggers to permit viewing of vertical fields and frames of video. A sweep time of 2ms/div. is appropriate for viewing fields of video and 5 ms/div. for complete frames (two interlaced fields) of video.

At most points of measurement, a composite video signal is of the (-) polarity; that is, the sync pulses are negative and the video is positive. In this case pull the **TRIGGER SLOPE** control out to (-) slope. If the waveform is taken at a circuit point where the video waveform is inverted, the sync pulses are positive and the video is negative, In this case push the **TRIGGER SLOPE** control in to (+) slope.

OSCILLOSCOPE APPLICATIONS

Applications Guidebook

B & K-Precision offers a "Guidebook to Oscilloscopes" which describes numerous applications for this instrument and important considerations about probes. It also includes a glossary of oscilloscope terminology and an understanding of how oscilloscopes operate. It may be obtained free of charge by filling out and mailing the postage-free coupon card enclosed with this instrument.

WARNING

The following instructions are for use by qualified service personnel only. To avoid electrical shock, do not perform any servicing other than contained in the operating instructions unless you are qualified to do so.

High voltage up to 11,500 V is present when covers are removed and the unit is operating. Remember that high voltage may be retained indefinitely on high voltage capacitors. Also remember that ac line voltage is present on line voltage input circuits any time the instrument is plugged into an ac outlet, even if turned off. Unplug the oscilloscope and discharge high voltage capacitors before performing service procedures.

FUSE REPLACEMENT

If the fuse blows, the oscilloscope will not operate. The fuse should not normally open unless a problem has developed in the unit. Try to determine and correct the cause of the blown fuse, then replace only with the correct value fuse. For 120 V line voltage operation, use a 2A, 125V, fuse. For 220 V line voltage operation, use a 1A, 250 V fuse. The fuse is located on the rear panel adjacent to the power cord receptacle.

Remove the fuseholder assembly as follows:

1. Unplug the power cord from the rear of the scope.
2. Insert a small screwdriver in fuseholder slot (located between receptacle and fuseholder). Pry fuseholder away from receptacle.
3. When installing fuseholder, be sure that the fuse is installed so that the correct line voltage is selected (see "Line Voltage Selection").

LINE VOLTAGE SELECTION

The voltage selector (fuseholder) assembly on the rear panel of the oscilloscope allows line voltage selection of nominal 100 V, 120 V, 220 V, or 240 V. The four line voltage choices are labeled on the assembly. To change line voltage, simply remove the assembly and reinsert it so that the arrow on the body points to the desired line voltage as labeled on the assembly. Change the fuse value to correspond with the value required for the new line voltage.

PERIODIC ADJUSTMENTS

Probe compensation and trace rotation adjustments should be checked periodically and adjusted if required. These procedures are given below.

Probe Compensation

1. Connect probes to **CH1** and **CH2** input jacks. Perform the procedure for each probe, one probe at a time.
2. Touch tip of probe to **PROBE ADJUST** Terminal.
3. Adjust oscilloscope controls to display 3 or 4 cycles of the probe adjust square wave at 5 or 6 divisions amplitude.
4. Adjust compensation trimmer on probe for optimum square wave (minimum overshoot, rounding off, and tilt). Refer to Fig. 6

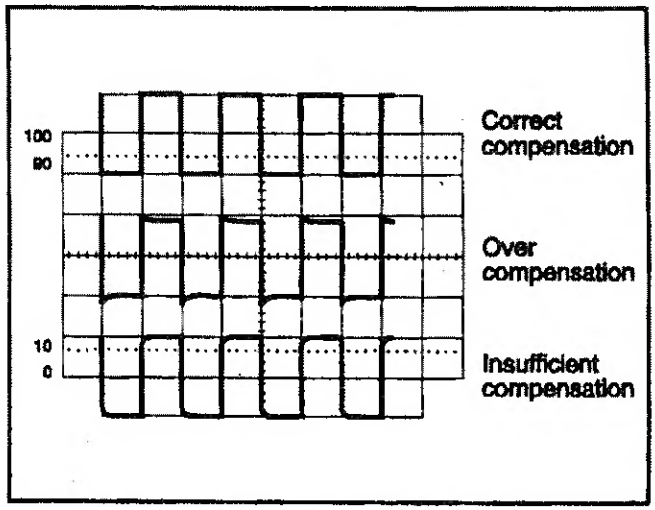

Fig. 6. Probe Compensation Adjustment

Trace Rotation Adjustment

1. Set oscilloscope controls for a single trace display (analog mode) in **CH1** mode, and with the channel 1 **AC/GND/DC** switch set to **GND**.
2. Use the ▲▼ **POSITION** control to position the trace over the center horizontal line on the graticule scale. The trace should be exactly parallel with the horizontal line.

3. Use the **TRACE ROTATION** adjustment on the front panel to eliminate any trace tilt.

CALIBRATION CHECK

A general check of calibration accuracy may be made by displaying the output of the **PROBE ADJUST** terminal on the screen. This terminal provides a square wave of 0.5 Vp-p. This signal should produce a displayed waveform amplitude of five divisions at 0.1 V/div. sensitivity for both channel 1 and 2 (with probes set for direct). With probes set for 10:1 there should be five divisions amplitude at 10 mV/div. sensitivity. The **VARIABLE** controls must be set to **CAL** during this check.

NOTE

The signal from the **PROBE ADJUST** terminal should be used only as a general check of calibration accuracy, not as a signal source for performing recalibration; a voltage standard calibrated at several steps and of ±0.3% or better accuracy is required for calibration adjustments.

The **PROBE ADJUST** signal should not be used as a time base standard.

INSTRUMENT REPAIR SERVICE

Because of the specialized skills and test equipment required for instrument repair and calibration, many customers prefer to rely upon **B+K Precision** for this service. We maintain a network of **B+K Precision** authorized service agencies for this purpose. To use this service, even if the oscilloscope is no longer under warranty, follow the instruction given in the WARRANTY SERVICE INSTRUCTIONS portion of this manual. There is a nominal charge for instruments out of warranty.

WARRANTY INFORMATION

LIMITED THREE-YEAR WARRANTY

MAXTEC INTERNATIONAL CORPORATION warrants to the original purchaser that its **B+K Precision** product, and the component parts thereof, will be free from defects in workmanship and materials for a period of three years from the date of purchase.

MAXTEC will, without charge, repair or replace, at its option, defective product or component parts upon delivery to an authorized **B+K Precision** service contractor or the factory service department, accompanied by proof of the purchase date in the form of a sales receipt.

To obtain warranty coverage in the U.S.A., this product must be registered by completing and mailing the enclosed warranty registration card to **B+K Precision**, 6470 West Cortland Street, Chicago, Illinois 60635 within fifteen (15) days from the date of purchase.

Exclusions: This warranty does not apply in the event of misuse or abuse of the product or as a result of unauthorized alterations or repairs. It is void if the serial number is altered, defaced or removed.

MAXTEC shall not be liable for any consequential damages, including without limitation damages resulting from loss of use. Some states do not allow limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific rights and you may also have other rights which vary from state to state.

For your convenience we suggest you contact your **B+K Precision** distributor, who may be authorized to make repairs or can refer your to the nearest service contractor. If warranty service cannot be obtained locally, please send the unit to **B+K Precision** Service Department, 6470 West Cortland Street, Chicago, Illinois 60635, properly packaged to avoid damage in shipment.

B+K Precision Test Instruments warrants products sold only in the U.S.A. and its overseas territories. In other countries, each distributor warrants the **B+K Precision** products which it sells.

WARRANTY SERVICE INSTRUCTIONS

(For U.S.A. and its Overseas Territories)

1. Refer to the MAINTENANCE section of your **B+K Precision** instruction manual for adjustments that may be applicable.
2. If the above-mentioned does not correct the problem you are experiencing with your unit, pack it securely (preferable in the original carton or double-packed).
3. Enclose a letter describing the problem and include your name and address.
4. Enclose proof of purchase date; that is, a dated copy of the sales receipt.
5. Deliver to, or ship PREPAID (UPS preferred in U.S.A.) to the nearest **B+K Precision** authorized service agency (see list enclosed with unit).

If your list of authorized **B+K Precision** service agencies has been misplaced, contact your distributor for the name of your nearest service agency, or writer to:

B+K Precision, Factory Service Operations
Maxtec International Corporation
6470 West Cortland Street
Chicago, Illinois 60635
Tel (312) 889-1448

Also use this address for technical inquiries
and replacement parts orders.